

**Product data representation and exchange: Application module: Foundation representation****COPYRIGHT NOTICE:****ABSTRACT:**

This document is a draft of the proposed application module for foundation representation.

**KEYWORDS:**

module, foundation, representation

**COMMENTS TO READER:**

This is a sample module for the WG10 STEP Modularization PWI.

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303-6xx was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data*.

ISO 10303 consist of the following parts under the general title *Industrial automation systems and integration* — *Product data representation and exchange*:

- Part 1, Overview and fundamental principles;
- Part 11, Description methods: The EXPRESS language reference manual;
- Part 12, Description method: The EXPRESS-I language reference manual;
- Part 21, Implementation methods: Clear text encoding of the exchange structure;
- Part 22, Implementation method: Standard data access interface specification;
- Part 23, Implementation method: C++ language binding to the standard data access interface;
- Part 24, Implementation method: C language binding to the standard data access interface;
- Part 26, Implementation method: Interface definition language binding to the standard data access;
- Part 31, Conformance testing methodology and framework: General concepts;
- Part 32, Conformance testing methodology and framework: Requirements on testing laboratories and clients;
- Part 34, Conformance testing methodology and framework: Abstract test methods;
- Part 35, Conformance testing methodology and framework: Abstract test methods for SDAI implementations;

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- Part 41, Integrated generic resources: Fundamentals of product description and support;
- Part 42, Integrated generic resources: Geometric and topological representation;
- Part 43, Integrated generic resources: Representation structures;
- Part 44, Integrated generic resources: Product structure configuration;
- Part 45, Integrated generic resource: Materials;
- Part 46, Integrated generic resources: Visual presentation;
- Part 47, Integrated generic resource: Shape variation tolerances;
- Part 49, Integrated generic resource: Process structure and properties;
- Part 101, Integrated application resource: Draughting;
- Part 104, Integrated application resource: Finite element analysis;
- Part 105, Integrated application resource: Kinematics;
- Part 106, Integrated application resource: Building construction core model;
- Part 201, Application protocol: Explicit draughting;
- Part 202, Application protocol: Associative draughting;
- Part 203, Application protocol: Configuration controlled design;
- Part 204, Application protocol: Mechanical design using boundary representation;
- Part 205, Application protocol: Mechanical design using surface representation;
- Part 207, Application protocol: Sheet metal die planning and design;
- Part 208, Application protocol: Life cycle management - Change process;
- Part 209, Application protocol: Composite and metallic structural analysis and related design;
- Part 210, Application protocol: Electronic assembly, interconnect, and packaging design;
- Part 212, Application protocol: Electrotechnical design and installation
- Part 213, Application protocol: Numerical control process plans for machined parts;

- Part 214, Application protocol: Core data for automotive mechanical design processes;
- Part 215, Application protocol: Ship arrangement;
- Part 216, Application protocol: Ship moulded forms;
- Part 217, Application protocol: Ship piping;
- Part 218, Application protocol: Ship structures;
- Part 221, Application protocol: Functional data and their schematic representation for process plant;
- Part 222, Application protocol: Exchange of product data for composite structures;
- Part 223, Application protocol: Exchange of design and manufacturing product information for casting parts;
- Part 224, Application protocol: Mechanical product definition for process plans using machining features;
- Part 225, Application protocol: Building elements using explicit shape representation;
- Part 226, Application protocol: Ship mechanical systems;
- Part 227, Application protocol: Plant spatial configuration;
- Part 229, Application protocol: Exchange of design and manufacturing product information for forged parts;
- Part 230, Application protocol: Building structural frame: Steelwork;
- Part 231, Application protocol: Process engineering data: Process design and process specification of major equipment;
- Part 232, Application protocol: Technical data packaging core information and exchange;
- Part 301, Abstract test suite: Explicit draughting;
- Part 302, Abstract test suite: Associative draughting;
- Part 303, Abstract test suite: Configuration controlled design;
- Part 304, Abstract test suite: Mechanical design using boundary representation;
- Part 305, Abstract test suite: Mechanical design using surface representation;

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- Part 307, Abstract test suite: Sheet metal die planning and design;
- Part 308, Abstract test suite: Life cycle management - Change process;
- Part 309, Abstract test suite: Composite and metallic structural analysis and related design;
- Part 310, Abstract test suite: Electronic assembly, interconnect, and packaging design;
- Part 312, Abstract test suite: Electrotechnical design and installation;
- Part 313, Abstract test suite: Numerical control process plans for machined parts;
- Part 314, Abstract test suite: Core data for automotive mechanical design processes;
- Part 315, Abstract test suite: Ship arrangement;
- Part 316, Abstract test suite: Ship moulded forms;
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- Part 321, Abstract test suite: Functional data and their schematic representation for process plant;
- Part 322, Abstract test suite: Exchange of product data for composite structures;
- Part 323, Abstract test suite: Exchange of design and manufacturing product information for casting parts;
- Part 324, Abstract test suite: Mechanical product definition for process plans using machining features;
- Part 325, Abstract test suite: Building elements using explicit shape representation;
- Part 326, Abstract test suite: Ship mechanical systems;
- Part 327, Abstract test suite: Plant spatial configuration;
- Part 329, Abstract test suite: Exchange of design and manufacturing product information for forged parts;
- Part 330, Abstract test suite: Building structural frame: Steelwork;
- Part 331, Abstract test suite: Process engineering data: Process design and process specification of major equipment;

- Part 332, Abstract test suite: Technical data packaging core information and exchange;
- Part 501, Application interpreted construct: Edge-based wireframe;
- Part 502, Application interpreted construct: Shell-based wireframe;
- Part 503, Application interpreted construct: Geometrically bounded 2D wireframe;
- Part 504, Application interpreted construct: Draughting annotation;
- Part 505, Application interpreted construct: Drawing structure and administration;
- Part 506, Application interpreted construct: Draughting elements;
- Part 507, Application interpreted construct: Geometrically bounded surface;
- Part 508, Application interpreted construct: Non-manifold surface;
- Part 509, Application interpreted construct: Manifold surface;
- Part 510, Application interpreted construct: Geometrically bounded wireframe;
- Part 511, Application interpreted construct: Topologically bounded surface;
- Part 512, Application interpreted construct: Faceted boundary representation;
- Part 513, Application interpreted construct: Elementary boundary representation;
- Part 514, Application interpreted construct: Advanced boundary representation;
- Part 515, Application interpreted construct: Constructive solid geometry;
- Part 517, Application interpreted construct: Mechanical design geometric presentation;
- Part 518, Application interpreted construct: Mechanical design shaded presentation.

The structure of this International Standard is described in ISO 10303-1. The numbering of the parts of the International Standard reflects its structure:

- Parts 11 to 12 specify the description methods,
- Parts 21 to 26 specify the implementation methods,
- Parts 31 to 35 specify the conformance testing methodology and framework,
- Parts 41 to 49 specify the integrated generic resources,

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- Parts 101 to 106 specify the integrated application resources,
- Parts 201 to 232 specify the application protocols,
- Parts 301 to 332 specify the abstract test suites, and
- Parts 501 to 518 specify the application interpreted constructs.

Should further parts be published, they will follow the same numbering pattern.

Annex A, B, C, D, and E form an integral part of this part of ISO 10303. Annexes F, G, H, J, and K are for information only.



## Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product, independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organized as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, application modules, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application module series.

This part of ISO 10303 specifies an application module for foundation representation.



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# **Industrial automation systems and integration — Product data representation and exchange — Part 6AA: Application module: Foundation representation**

## **1 Scope**

This part of ISO 10303 specifies the application module for foundation representation. The following are within scope of this part of ISO 10303:

- the definition of the basic concept of representation;
- how a representation may be formed.

The following are outside the scope of this part of ISO 10303:

- all things which are not involved in the specification of the concept of representation.

## **2 Normative references**

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 8824-1:1994, *Information technology — Open systems interconnection — Abstract syntax notation one (ASN.1) — Part 1: Specification of basic notation*.

ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*.

ISO 10303-11:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual*.

ISO/DIS 10303-41<sup>1</sup>, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resource: Fundamentals of product description and support*.

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<sup>1</sup> To be published.

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ISO/CD 10303-42<sup>1</sup>, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resource: Geometric and topological representation.*

ISO/DIS 10303-43<sup>1</sup>, *Industrial automation systems and integration — Product data representation and exchange — Part 43, Integrated generic resources: Representation structures.*

### 3 Terms, definitions, and abbreviations

#### 3.1 Terms defined in ISO 1101

For the purpose of this part of ISO 10303, the following terms defined in ISO 1101 apply.

- application;
- application protocol;
- data;
- information;
- integrated resource;
- product;
- product data.

### 4 Information requirements

This clause specifies the information requirements for foundation representation. The information requirements are specified as a set of units of functionality, application elements, and application assertions. These assertions pertain to individual application entities and to relationships between application entities. The information requirements are defined using the terminology of the subject area of this application module.

- A graphical representation of the information requirements is given in annex C.
- The mapping table is specified in 5.1 which shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements which are common to application modules and protocols.

#### EXPRESS specification:

```
* )  
SCHEMA foundation_representation_arm;  
( *
```

## 4.1 Units of Functionality

This subclause specifies the units of functionality (UoF) for the foundation representation application module as well as any support elements needed for the module definition. This part of ISO 10303 specifies the following units of functionality:

- foundation\_representation.

This part of ISO 10303 uses no other units of functionality.

The units of functionality and a description of the functions that each UoF supports are given below. The module entities included in the UoFs are defined in clause 4.3.

### 4.1.1 foundation representation

The foundation representation UoF specifies the definitional information for the concept of representation and how it is composed.

The following application entities are used by the elemental shape UoF:

- representation;
- representation\_context;
- representation\_item.

## 4.2 Referenced AM ARMs

This module references no other ARMS.

## 4.3 ARM entity definitions

This subclause specifies the application entities for the foundation representation module. Each application entity is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the entity. The application entities and their definitions are given below.

### 4.3.1 Representation

A Representation is an information data space which is founded in a Representation\_context (see 4.3.2) and contains one or more Representation\_items (see 4.3.3) as elements.

EXPRESS specification:

```
* )
ENTITY representation;
```

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```
name          : STRING;
items         : SET[1:?] OF representation_item;
context       : representation_context;
END_ENTITY;
( *
```

### Attribute definitions:

**name:** The name specifies the word or group of words by which the Representation is known.

**items:** The items specifies the set of Representation\_item instances which make up the representation.

**context:** The context specifies the foundation for the representation's domain.

### 4.3.2 Representation\_context

A Representation\_context is foundation for the definitional domain of the representation.

#### EXPRESS specification:

```
* )
ENTITY representation_context;
  identifier : STRING;
  kind       : STRING;
END_ENTITY;
( *
```

### Attribute definitions:

**identifier:** the label that distinguishes the Representation\_context.

**kind:** a description of the foundation domain's data space.

### 4.3.3 Representation\_item

A Representation\_item is a single element of a representation.

#### EXPRESS specification:

```
* )
ENTITY representation_item;
name : STRING;
END_ENTITY;

END_SCHEMA;
(*
```

Attribute definitions:

**name:** the label that distinguishes the Representation\_item.

## 5 Module Interpreted Model

### 5.1 Mapping Table

This clause contains the mapping table that shows how each UoF and application entity of this part of ISO 10303 (see 4) maps to one or several MIM resource constructs. The mapping table is organized in five columns. The contents of these five columns are:

Column 1) Application element: Name of an application element as it appears in the application entity definition. Application entity names are written in uppercase. Attribute names are listed after the application entity to which they belong and are written in lower case.

Column 2) MIM element: Name of an MIM element as it appears in the MIM, the term 'IDENTICAL MAPPING', or the term 'PATH'. MIM entities are written in lower case. Attribute names of MIM entities are referred to as <entity name>.<attribute name>. The mapping of an application element may result in several related MIM elements. Each of these MIM elements will require a line of its own in the table. The term 'IDENTICAL MAPPING' indicates that both application entities of an application assertion map to the same MIM element. The term 'PATH' indicates that the application assertion maps to the entire reference path.

Column 3) Source: For those MIM elements that are interpreted from the integrated resources, this is the number of the corresponding part of ISO 10303. For those MIM elements that are created for the purpose of this part of ISO 10303, this is the number of this part.

Column 4) Rules: One or more numbers may be given which refer to rules that apply to the current MIM element or reference path. For rules that are derived from relationships between application entities, the same rule is referred to by the mapping entries of all the involved MIM elements. The expanded names of the rules are listed after the table.

Column 5) Reference path: To describe fully the mapping of an application entity, it may be necessary to specify a reference path through several related MIM elements. The reference path column documents the role of a MIM element relative to the MIM element in the row succeeding it. Two or more such related MIM elements define the interpretation of the integrated resources that satisfies the requirement specified by the application entity. For each MIM element that has been created for use within this part of ISO 10303, a reference path up to its supertype from an integrated resource is specified.

For the expression of reference paths and the relationships between MIM elements, the following notational conventions apply:

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[] : multiple MIM elements or sections of the reference path are required to satisfy an information requirement;

() : multiple MIM elements or sections of the reference path are identified as alternatives within the mapping to satisfy an information requirement;

{ } : enclosed section constrains the reference path to satisfy an information requirement;

-> : attribute references the entity or select type given in the following row;

<- : entity or select type is referenced by the attribute in the following row;

[i] : attribute is an aggregation of which a single member is given in the following row;

[n] : attribute is an aggregation of which member n is given in the following row;

=> : entity is a supertype of the entity given in the following row;

<= : entity is a subtype of the entity given in the following row;

= : the string, select or enumeration type is constrained to a choice or value;

\ : the line continuation for strings that wrap.



**Table 1 - Mapping table for foundation representation UoF**

Application_element	MIM element	Source	Rules	Reference path
representation	representation	43		
name	name			
items context	items context			
representation_context	representation_context	43		
identifier	context_identifier			
kind	context_type			
representation_item	representation_item	43		
name				

## 5.2 Module EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources or application interpreted constructs and contains the types, entity specializations, rules, and functions that are specific to this part of ISO 10303. This clause also specifies modifications to the textual material for constructs that are imported from the integrated resources. The definitions and EXPRESS provided in the integrated resources or application interpreted constructs for constructs used in the MIM may include select list items and subtypes which are not imported into the MIM. Requirements stated in the integrated resources or application interpreted constructs which refer to such items and subtypes apply exclusively to those items which are imported into the MIM.

### EXPRESS Specification:

```
* )  
SCHEMA foundation_representation_mim;  
  USE FROM representation_schema -- ISO 10303-43  
    (representation);  
END_SCHEMA;  
(*
```

NOTE 1 - See annex D for a graphical presentation of this schema using the EXPRESS-G notation.

NOTE 2 - The schema referenced above can be found in the following part of ISO 10303:

representation\_schema

ISO 10303-43

**Annex A**  
(normative)

**MIM short names of entities**

Table A.1 provides the short names of entities specified in this part of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

**Table A.1 - MIM short names of entities**

Entity Names	Short Names

**Annex B**  
(normative)

**Information object registration**

**B.1 Document identification**

To provide for unambiguous identification of an information object in an open system, the object identifier

{ iso standard 10303 part(6AA) version(0) }

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

**B.2 Schema identification**

To provide for unambiguous identification of the schema specification given in this application module in an open information system, the object identifiers are assigned as follows:

{ iso standard 10303 part(6AA) version(0) object(1) foundation-representation-mim-schema(1) }

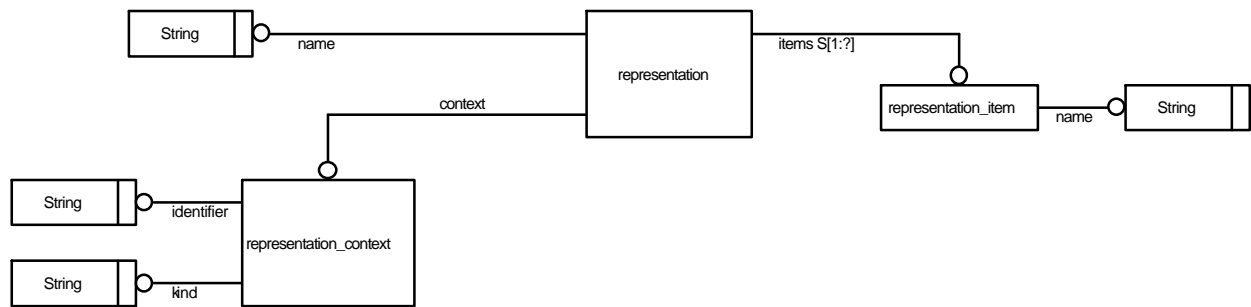
is assigned to the foundation\_representation\_mim schema.

{ iso standard 10303 part(6AA) version(0) object(1) foundation-representation-mim-schema(2) }

is assigned to the foundation\_representation\_mim schema short form schema (see 5.2). The meaning of this value is defined in ISO 8824-1, and is described in ISO 10303-1.

**Annex C**  
(informative)

**ARM EXPRESS-G**



**Figure C.1 - ARM diagram 1 of 1**

**Annex D**  
(informative)

**MIM EXPRESS-G**

The following diagrams correspond to the MIM EXPRESS expanded listing given in Annex E. The diagrams use the EXPRESS-G graphical notation for the EXPRESS language. EXPRESS-G is defined in annex A of ISO 10303-11. Note that the inter-page referencing is to the diagram number and not the figure number.

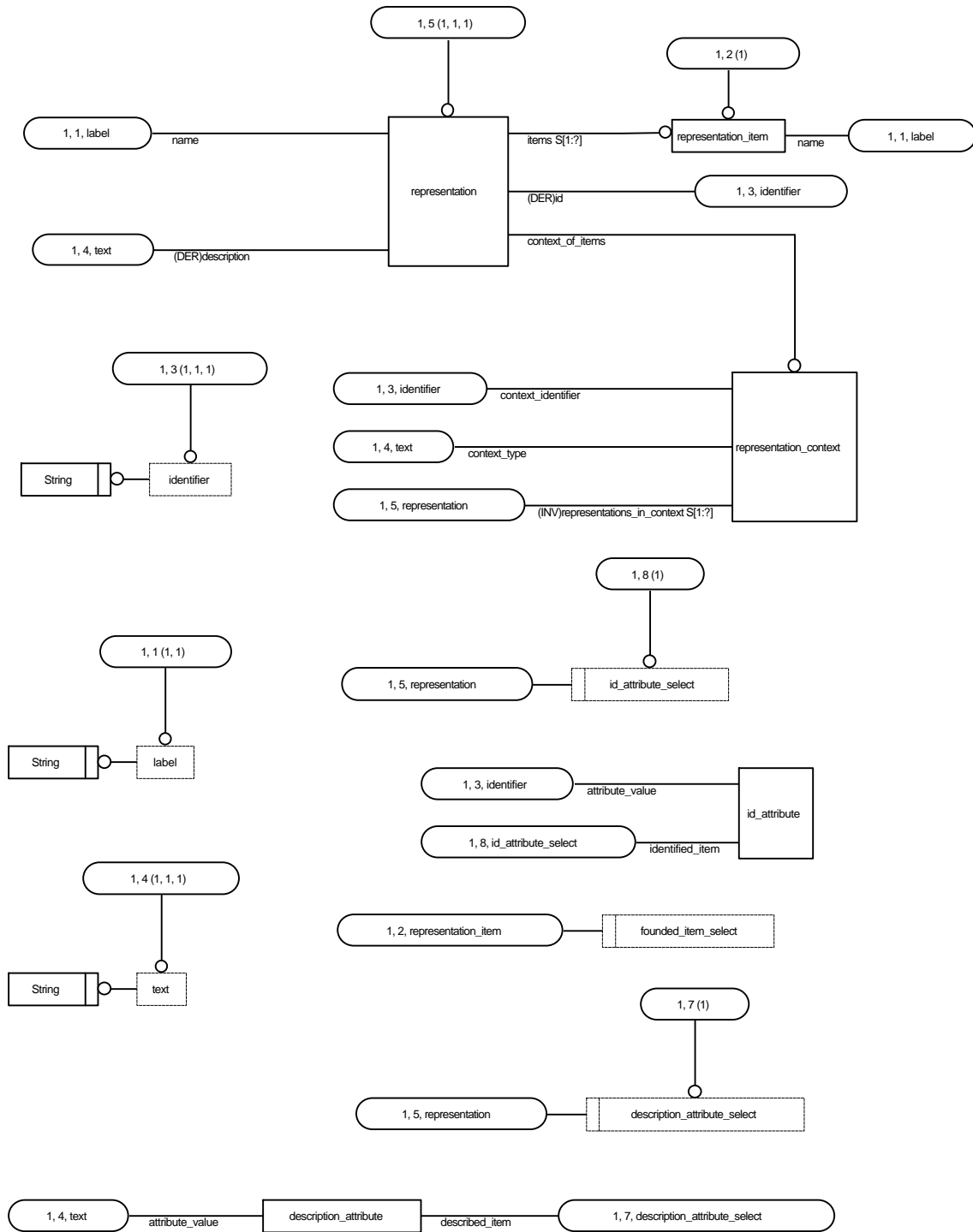


Figure D.1 - MIM EXPRESS -G diagram 1 of 1



**Annex E**  
(informative)

**AM ARM and MIM EXPRESS**

This annex provides a listing of the EXPRESS for the ARM specified in clause 4 and expanded EXPRESS schema specified in clause 5.2 of this part of ISO 10303 without comments or other explanatory text. It also provides a listing of the EXPRESS entity names and corresponding short names as specified in annex B of this part of ISO 10303. The content of this annex is available in computer-interpretable form and can be found at the following URLs:

**Annex F**  
(informative)

**Application module implementation and usage guide**

**Annex G**  
(informative)

**Technical Discussions**

**Annex H**  
(informative)

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